Ambition and Ambivalence

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Abstract

Science matters. Science matters to the development of knowledge, to the sustainability of development, and to the shaping of social mores. Countries transitioning from developing to developed must be prepared to make science work for them and to forge a vision to become competitors in some aspects of science innovation. Drawing on data generated by the "Governing Emerging Technologies: Social Values and Stem Cell Regulation in Argentina" Project (ESRC Award No. RES-000-22-2678), this paper (1) places the current Argentine bioscience setting in context by reviewing the development of biosciences in Argentina, (2) explores understandings of the social dimensions of bioscience innovation in Argentina and the possibilities of enhancing public support for science, and (3) offers some preliminary thoughts on a model for socio-legal activity directed at encouraging social engagement with and the uptake of high technologies in Argentina (i.e., the possibilities for generating a positive and facilitative "sci-tech culture" in Argentina).

KEYWORDS: Argentina, developing countries, social values, engagement, participation, regulation, science and technology, stem cells

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INTRODUCTION

It is a fact of the modern, global, information/knowledge-based socio-economic milieu that 'science and innovation matter'. Capacity, activity and innovation in high technologies are widely seen to be (and therefore are) important elements of sustainable development, critical to social and economic life in the new world order, which is characterised by unstable global economics, collaborative international science, near instant communication, and, arguably, socio-cultural convergence. Indeed, both governments and non-governmental organisations are seeking to use the sci-tech field as an engine for growth and competitiveness. The biosciences sector more specifically, together with nanotechnology, has proven very appealing to industry, academia, policy-makers, and segments of the polity, who see them as important vehicles for the delivery and advancement of modern healthcare (Scientific American). Within the biosciences, regenerative medicine and its related biotechnologies have emerged as particularly powerful mobilisers. They are noteworthy because their significance goes well beyond the economic; from a social perspective they are 'change-instigators'. For example, they:

- redefine how we characterise health and ill-health, normalcy and abnormality;
- influence how we investigate health and disease;
- transform our ideas of what might be possible from a health perspective; and
- shape how we structure healthcare delivery.

However, becoming a leader (or even a competitor) in the emerging (bio)techno-based era places a variety of demands on policymakers. They must:

- commit significant financial and human resources to a variety of (bio)technologies;
- target specific (bio)technologies in which to build national strengths;
- understand how knowledge is generated and facilitate its creation/dissemination; and
- encourage the (relatively) rapid uptake and (relatively) smooth integration of technologies into society.

Each of these demands are challenging, especially for countries transitioning from economic and/or social instability to some more robust and resilient level of development. Nonetheless, as experience from China and the UK attest, each must be positively and actively engaged with if capacities are to be strengthened and competitiveness encouraged.

It is towards the last of these demands – facilitating the social uptake and integration of technologies – that this paper is directed. While this demand has many facets, this paper will focus only on the social dimension, addressing the interaction of science and scientists with the community and the role of science communication. In considering this broad issue, it will draw on evidence obtained from Argentina on a narrower issue – stem cell and reproductive medicine research and its governance. First, it briefly outlines the empirical project and methodology on which the analysis and conclusions rely. Second, it places the current Argentine bioscience setting in context by briefly reviewing the development of bioscience in Argentina. Third, drawing on the project data, it explores understandings of the social dimensions of bioscience innovation in Argentina, and the possibilities of enhancing public support for stem cell and regenerative medicine research in Argentina. Fourth, it offers some preliminary thoughts on a model of socio-legal activity directed at encouraging social engagement with, and uptake of, high technologies such as these, noting the particular hurdles that must be faced in Argentina. The paper concludes by emphasising that stakeholder desires (as evidenced by respondent statements) must be wedded to positive stakeholder action despite the multiple challenges (and pitfalls) identified.

THE 'GET: SOCIAL VALUES' PROJECT: A METHOD OF EVIDENCE-GATHERING IN THE ARGENTINE BIOSCIENCE CONTEXT

The data which forms the basis of the following analysis was generated by a project entitled 'Governing Emerging Technologies: Social Values and Stem Cell Regulation in Argentina' (ESRC Responsive Grant Award No. RES-000-22-2678).[1] Following participation in two preliminary policy conferences, we conducted 22 semi-structured interviews with diverse stakeholders in the

[1] For more on the GET: Social Values Project, see http://www.law.ed.ac.uk/ahrc/esrcvaluesproject/, or go to ESRC Society Today at http://www.esrcsocietytoday.ac.uk/ESRCInfoCentre/ViewAwardPage.aspx?data=%2fFrXHTl993o2s3j2qzndQ%2btMvLMb0c%2ba0yxfTTX2AHVlOW%2bL7eMI%2f6qVw9YoT8G3jr7S83IFcVwVQf7LeaV9OUrixXUodr65P0aHNkG8IOUtyKQw%2f33F7mTLpnKmhpUrwJMULgcuCcAEYBqEOe5Ee7oV%2fluZamljCzOhpptxWZGaWc5VwiKA1Tnox0xhzAl0hIB4X%2fcoTpHqbTmfGH7%2fp4%2f%2fyqUPSi96jyp%2bSGYDGLgb7R26FoE9r0YlHAVoUmQx&xu=0&isAwardHolder=&isProfiled=&AwardHolderID=&Sector=.

Argentine stem cell field, and co-hosted an interactive workshop together with the Argentine Advisory Commission on Regenerative Medicine and Cellular Therapies, which workshop was attended by some 40 invited participants.[2]

Given the relative dearth of work on the interaction of social values and law in the stem cell research context – with its tensions between promoting science, managing stakeholders, and limiting risks – and of its pursuit in developing countries, the GET: Social Values Project was designed and funded with the intention of gathering qualitative data around key issues of bioscience and in particular stem cell research governance in Argentina. While the data generated cannot be said to represent the Argentine view – the subject sample was too narrow and too small for such claims – it represents important qualitative evidence of the opinions and views of key stakeholders in the field. Moreover, it has been welcomed by relevant stakeholders as an early and important, if small, project examining the social context of bioscience (and stem cell) innovation in Argentina, and it has enjoyed the support of the Argentine policymaking community, which has facilitated access to some of those most interested in, and relevant to, stem cell research governance.

Prior to commencement, the GET: Social Values Project was subject to initial institutional ethics review and then funding body ethics evaluation. Research participants were chosen from the medical and scientific, academic and policy, and legislative and regulatory communities.[3] As the project was never intended to be a public engagement mechanism, the opinions of the broader general public were not solicited. Rather, those originally viewed as most likely to influence the nature and content of bioscience and stem cell regulation in

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[2] The two policy conferences were the "Regulation of Clinical Research Involving Stem Cells", hosted by the (then) Argentine Science and Technology Agency in Buenos Aires on 29-30 November 2007, and the "Second International Conference on the Regulation of Stem Cells and Human Tissue", hosted by the Advisory Commission on Regenerative Medicine and Cellular Therapies in Buenos Aires on 14 October 2008. For a report on the former, see S. Harmon, G. Laurie and F. Arzuaga, "Report: Regulation of Clinical Research Involving Stem Cells: Towards the Construction of a Regulatory Model for Argentina Learning from the Experiences of the United Kingdom" (2007), available at http://www.law.ed.ac.uk/ahrc/esrcvaluesproject/files/Report%20Nov%2007%20Stem%20Cell%20Workshop.pdf. The workshop, "The Regenerative and Cellular Sciences: Values, Objectives and Issues for Implementation – An Interactive Workshop", was co-hosted by the GET: Social Values Project and the Advisory Commission on Regenerative Medicine and Cellular Therapies in Buenos Aires on 18 August 2009. For a report on this workshop, see S. Harmon, "Regenerative Medicine Governance: Report of the Workshop on Governance of Research Using Human Embryonic Tissue" (2009) 6:3 SCRIPTed 729-740.

[3] The investigators interviewed at least one respondent, but often multiple respondents, from each of the following categories: cabinet level politician; national congressional member; national regulatory agency member; national advisory committee member; medical clinician, medical researcher, basic scientist, ethicist, academic lawyer.

Argentina were targeted (ie: Argentine science policy elites), for, it was felt, only by targeting those most engaged in the pre-legislative process might we measure the existence of functional connections between values and objectives, on the one hand, and legal outputs (when they emerge), on the other.

Following preliminary desktop research, semi-structured interviews lasting 50 to 90 minutes were conducted. Each interview was, with permission, recorded. Open-ended questions and an informal interview schedule were used to encourage participants to speak in their own words about their experiences, observations, opinions, and desires. In some cases, more structured information was obtained through questionnaires. Transcription of the interviews was performed within Innogen (one the Principal Investigator's host institutes) and that work was subject to a signed Confidentiality Agreement. Anonymised transcripts were shared between the Principal Investigator and the Collaborating Investigator and have been retained for archiving. Every line of transcript and interviewer notes was coded and analysed for emergent themes, and sections relating to those themes were grouped together, and the whole assessment refined through an iterative process, thus enabling different perspectives and interpretations to be incorporated.

The quotes utilised in the present paper were chosen as representative of widely canvassed themes, and are deployed to make particular points or support particular claims or recommendations.

BIOSCIENCE DEVELOPMENT IN ARGENTINA: FROM 'SCIENCE PERIPHERY' TO 'HIGH-SCIENCE HUB'?

Despite being a developing or transitioning country, Argentina has a long history of scientific competence and success, right up to the present.[4] In the late 19th century, Domingo Sarmiento, President of Argentina, and Juan María Gutiérrez, Rector of the University of Buenos Aires (UBA), adopted a policy of drawing immigrant scientists to Argentina. By the early-mid 20th century, native researchers such as Bernardo Houssay, who won a Nobel Prize in 1947 for his work on the function of the hypophysis, and Luis Leloir, who won a Nobel Prize in 1970 for his work on metabolic pathways, were conducting early biomedical science (eg: molecular biology and chemistry) and collaborating with the international scientific community; they were forging an Argentine context that

[4] See S. Maheshwari, "Cloned Cows Can Produce Insulin in Their Milk, Claim Their Creators" (2007) *Free Press Release*, available at http://www.free-press-release.com/news/200705/1178276885.html [accessed 4 August 2009], and M. Triunfol, "Latin American Science Moves into the Spotlight" (2007) 131 *Cell* 1213-1216.

has been described as "scientific excellence in the periphery".[5] Since those halcyon days (for Argentine science and Argentina generally), a number of distinct scientific periods and characterisations are discernable (though not uncontroversial or uncontested):[6]

- 1945-55 – Peronist-Prompted Exodus: Under the centralist Peronist regime, science was perceived as elitist, and many scientists, who were primarily employed in public universities such as UBA, were dismissed, with many choosing exile, some in independent domestic institutes, most in foreign labs. Between 1950 and 1956, hundreds of scientists and professionals left Argentina.

- 1956-66 – Houssay-Led Golden Decade: Following the fall of Perón, science was restored as a respected and publicly supported endeavour. The National Council for Scientific and Technological Development (CONICET) was formed in 1958 under Houssay and instituted a degree programme for research, a grant scheme for young researchers, and subsidies for investigators. Ongoing international collaborations were encouraged and the research sector positively bloomed as space was created for the generation of new knowledge. Scientists returned to Argentina in numbers, including César Milstein, who subsequently won a Nobel Prize in 1983 for his work on monoclonal antibodies. Importantly, this was a period of scientific independence from political power and social oversight, though a schism developed between those scientists who

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5 See P. Kreimer, "Migration of Scientists and the Building of a Laboratory in Argentina" (1997) 2 *Science, Technology & Society* 229-259. See also H. Vessuri, "Bitter Harvest: The Growth of a Scientific Community in Argentina" in J. Gaillard, V. Krishna and R. Waast, eds., *Scientific Communities in the Developing World* (London: Sage 1997) 307-335.

6 See P. Kreimer, *ibid*, P. Kreimer, "Science and Politics in Latin America: The Old and the New Context in Argentina" (1996) 1 *Science, Technology & Society* 267-289, A. Paladini and A. Barrios Medina, *Escritos y discursos del Dr. Bernardo Houssay* (Buenos Aires: EUDEBA, 1990), M. Bastos, "What Hope can Democracy Bring to S&T Policy Making in Latin America? INTECH Discussion Paper" (1995), available at http://www.intech.unu.edu/publications/discussion-papers/9505.pdf [accessed 1 December 2009], P. Kreimer and M. Lugones, "Rowing Against the Tide: Emergence and Consolidation of Molecular Biology in Argentina, 1960-90" (2002) 7 *Science, Technology & Society* 285-311, P. Kreimer and M. Lugones, "Pioneers and Victims: The Birth and Death of Argentina's First Molecular Biology Laboratory" (2003) 41 *Minerva* 47-69, A. Feld and P. Kreimer, "Internationalism and Cooperation in Science and Technology Policies in Argentina: Origins and Current Challenges", presented at PRIME-Latin America Conference, Mexico City, 24-26 September 2008, A. Parson, "PABSELA: A Research Highway Between Two Hemispheres" (2008) 2 *Cell: Stem Cell* 414-415, and others.

advocated pure science and those who advocated science for social needs (or local usefulness).

- 1966-83 – Dictatorial Persecution and Exodus: While the dictatorship viewed certain sciences as essential to its cause (including physics and nuclear and aerospace sciences and related technologies), the previously rapid growth of Argentine science was halted by the military's seizure of power in 1966, which resulted in the dissolution of much academic science. Following the '*noche de los bastones largos'* (night of the long canes) there were mass resignations from science faculties (including some 8,600 from UBA), and a progressive exodus of scientists and professionals from Argentina to whatever jurisdictions offered professional opportunities. After a very brief democratic reprieve in the early 1970s, the resumption of military rule was accompanied by persecution, assassination and torture. A further exodus followed, this time to preserve life rather than professional opportunities, and a near complete disintegration of the technology policy framework was experienced.

- 1983-2000s – Restoration and Crisis: When democracy was restored, the new government promoted science as a valued undertaking, and many scientists returned to Argentina, but resources were woefully inadequate, and the scientific community became more competitive and less collegial. By the mid-1990s, the number of Argentine researchers working abroad exceeded the number of career CONICET researchers, and the international character of science left little room for Argentina, whose scientific community was often oriented toward topics of a non-essential and non-urgent nature. It was perhaps a perception of irrelevance that contributed to the opinion, expressed in 1994 by the then Minister of the Economy, that Argentina's scientists should devote their time to washing dishes. The financial crisis in the early years of the new millennia caused further disruption to Argentine science and innovation, both of which suffered through a period of depressed funding. Indeed, funding was only raised to (the still low amount of) 0.65% GDP in 2003. Even leading institutions such as the Leloir Institute often relied on outdated equipment.

Though the cumulative effect of this history was the attenuation of Argentine sci-tech capacity, there nonetheless endured a rich vein of biomedical research interest and excellence in Argentina, and the field was facilitated by the creation in 1982 of the National Programme for Biotechnology and Genetic Engineering (which became the National Prioritised Programme for Biotechnology in 1991), and by the formation of a number of centres, fora and commissions between 1985

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and 1999.[7] In short, in keeping with the widely held view that technological innovation is an integral part of human existence (even survival), it again become the policy of Argentina to build competitiveness in high sciences, particularly the biosciences where Argentina has enjoyed success. In furtherance of that policy, Argentina has:

- promoted international networks and made public funds available so that it might better compete;[8]

- formed the first Ministry of Science, Technology and Productive Innovation (in 2007), which has undertaken a variety of initiatives to stimulate science and research excellence, including the formation of the Advisory Commission on Regenerative Medicine and Cellular Therapies;

- issued governmental press releases calling attention to the benefits of biosciences like stem cell research;[9] and

- signed international agreements with specified groups to promote scientific innovation and international cooperation.[10]

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[7] For example, note the formation of the Argentine-Brazilian Centre for Biotechnology (1985), the Argentine Forum for Biotechnology (1986), the National Commission for Agricultural Biotechnology (1990), the National Commission for Biotechnology and Health (1993), and the Commission for Bioethics and Biotechnology in the Chamber of Deputies (1999).

[8] See E. Trigo and E. Cap, "Ten Years of Genetically Modified Crops in Argentine Agriculture" (2006), available at http://www.inta.gov.ar/ies/docs/otrosdoc/resyabst/ten_years.htm [accessed 4 August 2009], W. Surman, "GM Crops in Argentina" (2007) *New Agriculturalist*, available at http://www.new-ag.info/07/02/develop/dev2.php [accessed 4 August 2009], and J. Niosi and S. Reid, "Biotechnology and Nanotechnology: Science-Based Enabling Technologies as Windows of Opportunity for LCDs" (2007) 35 *World Development* 426-438. It should be noted that, in Argentina, the government remains the primary funding source for science, with the majority of research being performed in governmental institutions and universities: Ministerio de Ciencia y Tecnología de la República Argentina, *Indicadores Ciencia Y Tecnologia: Argentina 2006*, available at http://www.mincyt.gov.ar/indicadores_2006/publicacion/indicadores_2006.pdf [accessed 13 January 2010].

[9] See Argentine Science and Technology Commission, National Congress, available at http://www.mincyt.gov.ar/index.php?contenido=comision_celulas_madre1/ [accessed 3 August 2009], and Argentine Regenerative Medicine and Cellular Therapies Commission, Ministry of Science, Technology and Productive Innovation, available at http://www.mincyt.gov.ar/index.php?contenido=comision_celulas_madre1/ [accessed 3 August 2009].

[10] N. Bar, "El Rating de la Ciencia. *La Nación*", 13 May 2009, available at http://rcdtx.lanacion.com.ar/nota.asp?nota_id=1127536 [accessed 3 August 2009].

While Argentina's efforts to build high technology strength as a means of development has been noted,[11] and while some elements of Argentine research have been described as "close to the 'frontier' of international knowledge",[12] Argentina remains some (substantial) distance from being a "high-science hub",[13] a fact which was well recognised by all respondents in the GET: Social Values Project. Nonetheless, and despite a general pessimism toward the government's capacity or will to realise Argentina's science potential through sufficient funding or rational policy,[14] there was expressed a cautious optimism about bioscience research in Argentina, with respondents claiming that it is expanding, and that, aside from some presumed and some specifically known exceptions, the quality of existing research is very good. Respondent 5 (R5) stated:

> … As a consequence of the interest of the Minister of Science, I think this [stem cell research] is one of the things that is growing fast in the country. … But now we have, besides these ten [stem cell] projects, this cluster for stem cell research that involves nine different institutions in the country with fourteen different projects.

R7 concurred that stem cell science is becoming important, saying, "It's a very interesting line of research, quickly growing here, quickly growing." R17 stated:

> We are behind the development in the rest of the world. And I want to see a change about this because I think we can work in both … the basic way and in the clinical trials.

Similarly, R18 thought that science funds should be used to gain experience so that Argentine research could be done "expertly". R21 was hopeful that concrete developments could be made in Argentina in the upcoming years such that new models and new techniques for applying stem cells could be achieved which might facilitate clinical practice.

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[11] See K. Thorn, "World Bank Working Paper: Science, Technology and Innovation in Argentina: A Profile of Issues and Practices" (2005), available at http://siteresources.worldbank.org/intargentina/resources/sciencetechnologyandinnovationinargentina.pdf [Accessed 3 Oct 2006], H. Greenwood et al., "Regenerative Medicine: New Opportunities for Developing Countries" (2006) 8 *International J Biotechnology* 60-77, and S. Harmon, "Emerging Technologies and Developing Countries: Stem Cell Research (and Cloning) Regulation and Argentina" (2008) 8 *Developing World Bioethics* 138-150.

[12] See P. Kreimer and M. Lugones, *supra*, note 6, at 306.

[13] See A. Parson, *supra*, note 6.

[14] In this regard, note that a tension continues to exist between policies and funding for knowledge production and knowledge application. Chagas disease is an example of an Argentine (and Latin American) problem that has garnered both social and scientific attention but not funding sufficient to see the development of useful products to market: see A. Feld and P. Kreimer, *supra*, note 6.

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Ultimately, then, while Argentina may fall short of 'high-science hub' status, there is ambition and an increasing mobilisation of science resources, particularly since the appointment of Lino Barañao as Minister of Science, who respondents acknowledged as a rare breed in the upper echelons of government insofar as he has scientific knowledge, realistic objectives, and widespread respect. However, the cautious optimism (and hopefulness) that was generally shared by all respondents was almost always tied to a perceived need to do a number of things better. One such thing is to understand the association between science promotion and scientific robustness on the one hand and scientific democracy on the other, and to integrate that democratic dimension into science endeavours and policies.

THE DEMOCRATIC DIMENSION OF BIOSCIENCE INNOVATION: DESIRES AND HUDLES IN THE ARGENTINE SETTING

Public engagement with respect to science and emerging technologies has become a hallmark of many modern knowledge-based political economies, particularly those in Europe and North America. It is likely that this is so because of the many benefits that are claimed to derive from appropriate public communication of science and technology. For example, studies show that it:

- promotes curiosity and inspires imagination;[15]
- arms people with the knowledge to develop within, and face challenges posed by, modern society;[16]
- places science in its proper socio-political context;[17]
- promotes science as an activity;[18] and
- encourages the vocational uptake of science,[19] including in Argentina.[20]

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15 M. Alcíbar, "Discursive Re-Contextualisation of the Media Popularisation of Science and Technology" (2004) 31 *Anàlisi* 43-70.

16 M. Calvo Hernando, *Periodismo Cientifico* (Madrid: Paraninfo, 1992).

17 Y. Jeanneret, *Writing Science* (Paris: Presses Universitaires de France, 1994).

18 P. Fayard, *La Communication Scientifique Publique* (Lyon: Chronique Sociale, 1988).

19 D. Nelkin, *Selling Science: How the Press Covers Science and Technology* (New York: W.H. Freeman, 1987).

20 G. Stekolschik et al., "Does the Public Communication of Science Influence Scientific Vocation? Results of a National Survey" (2009) *Public Understanding of Science*, available at http://pus.sagepub.com/cgi/rapidpdf/0963662509335458v1 [accessed 5 January 2010].

However, if communication or engagement is to be effective, it must be something more than piece-meal responses or reactions to assaults against science; it must be ongoing and creative, and it must become embedded. Indeed, one might argue that any attempt to develop through science and/or technology, or, more ambitiously, to build advantages (regional if not international) in targeted high-technologies such as biomedicine, must be accompanied by efforts to develop a 'sci-tech culture',[21] if not broadly, then at least sectorally.

A 'sci-tech culture' is a socio-scientific-political condition of familiarity and comfort with science. It is an environment wherein stakeholders recognise that the development of science and technology is (1) uncertain and risk-bound (requiring boundaries to be tested and pushed, sometimes with unknown consequences), and (2) controversial and value-laden (not neutral, but grounded in the protagonists' values and desires), and that, despite these characteristics, technological innovation is still facilitated and is the accepted norm. This culture fosters a reasonable tolerance for envelope-pushing and risk-taking by encouraging rational and interactive social consideration of science. It does not demand a blind acceptance of all science and its outputs, but rather a mature understanding of science, its potentialities, and its social impacts, with a recognition that *good* science and socially *useful* technologies flourish when they are encouraged and celebrated rather than endangered or embattled; it requires recognition by people that one need not choose between science and other closely held or traditional values; they are not mutually exclusive but can be used in cooperation to achieve valued ends.

Of course, one cannot expect the adoption of a sci-tech culture to be monolithic – not all people will embrace technology, and, of those who do, reasonable disagreement over all manner of issues might be expected. In short, plurality can be anticipated. Some disagreement might be forestalled by ensuring that research (and certainly research supported by public funds) is clearly directed toward addressing pressing public issues. But reducing *hostility* towards technology, and narrowing disagreement over its pursuit and deployment is, in many respects, a matter of debate and engagement which must be facilitated by public institutions and mediated through publicly accepted mechanisms. As

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[21] A sci-tech culture can be differentiated from a technoscience culture in that the former is a socio-political culture facilitative of science and technology uptake while the latter, though perhaps incorporating some of the same, is characterised by technology convergence and is lamented as being characterised by the elevation of technology over pure science for its own sake: see P. Forman, "The Primacy and Science in Modernity, of Technology in Postmodernity, and of Ideology in the History of Technology" (2007) 23 *History and Technology* 1-152, B. Bensaude-Vincent, "Technoscience and Convergence: A Transmutation of Values?" (2008), available at http://hal.archives-ouvertes.fr/docs/00/35/08/04/PDF/06BBV.pdf [accessed 5 July 2010], and others.

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should be obvious, it is the responsibility of democratic governments and invested stakeholders to co-opt and mobilise interested segments of the polity and to work cooperatively to forge this culture and to build support by *empowering* the public to express their *true* desires and values.

It may come as little surprise that a sci-tech culture does not exist in Argentina.[22] Dating as far back as Argentina's Golden Decade, science communication has not been something that has been vigorously promoted. Indeed, many of the formal or institutional voices in Argentina, where they have addressed science at all, have been characterised as anti-science, and are at least very selective in the types and scope of science that they accept. For example, despite value heterogeneity across society, and despite a widespread break from church dogma in personal practices,[23] much of the public narrative on reproductive health, abortion and stem cell research has been driven by the conservative position of the Catholic Church,[24] and reiterated by a conservative press and judiciary.[25] Nonetheless, given the increasingly transformative nature of biosciences like stem cell research, and given the amount of public funds spent on regenerative medicine, even in Argentina, it is reasonable to expect that programmes/policies should be girded by public consideration (and support).[26]

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[22] In fact, the existence anywhere of a true or fully realised sci-tech culture is in some doubt. South Korea, the USA, the UK, and latterly, China, probably represent the closest examples.

[23] M. Gogna et al., "Abortion in a Restrictive Legal Context: Obstetrician-Gynaecologists in Buenos Aires, Argentina" (2002) 10 *Reproductive Health Matters* 128-137, and F. Luna and A. Salles, "On Moral Incoherence and Hidden Battles: Stem Cell Research in Argentina" (2010) *Developing World Bioethics*, early online at http://www3.interscience.wiley.com/cgi-bin/fulltext/123243513/PDFSTART [accessed 11 June 2010].

[24] See Congregation for the Doctrine of the Faith, *Instruction Donum Vitae on Respect for Human Life in its origin and on the Dignity of Procreation* (1987), available at http://www.vatican.va/roman_curia/congregations/cfaith/documents/rc_con_cfaith_doc_19870222_respect-for-human-life_en.html [accessed 3 August 2009], Pontifical Academy for Life, *Declaration on the Production and the Scientific and Therapeutic Use of Human Embryonic Stem Cells* (2000), available at http://www.vatican.va/roman_curia/pontifical_academies/acdlife/documents/rc_pa_acdlife_doc_20000824_cellule-staminali_en.html [accessed 21 April 2009], and Congregation for the Doctrine of the Faith, *Instruction Dignitas Personae on Certain Bioethical Questions* (2008), available at http://www.vatican.va/roman_curia/congregations/cfaith/documents/rc_con_cfaith_doc_20081208_dignitas-personae_en.html [accessed 3 August 2009].

[25] See F. Luna and A. Salles, *supra*, note 23, and S. Chaher et al., "El Aborto en la Prensa Gráfica Argentina: Monitoreo de 10 Casos" (2008), available at http://www.artemisanoticias.com.ar/images/FotosNotas/informe%20monitoreo%20final6-08%5B1%5D.pdf [accessed 3 August 2009].

[26] P. Tigeras Sánchez and J. Pérez del Val, "Science and Society: A Dialogue for the Future", in B. Bonmatí, ed., *Scientific Knowledge and Cultural Diversity: PCST-8 Proceedings* (Barcelona: Rubes Editorial, 2004) 407-409.

With respect to the respondents in the GET: Social Values Project, while some reported being involved in closed-doors debates – usually with colleagues or within professional organisations, including ethics committees, and sometimes with individual government representatives – none had taken part in any broad social debates about stem cell research, nor were they aware of any such debates, although two noted that stem cell and reproductive research had, recently, been the subject of some popular magazine articles. Despite this relative silence, most recognised the value of engaging with the public over bioscience and other sci-tech issues. However, respondents felt that certain barriers made good science communication (and the concomitant development of a sci-tech culture) particularly challenging and potentially conflictual in Argentina, and they identified several key challenges:

1. the perceived anti-science position of the Catholic Church, which neither fosters nor embraces rational debate;

2. the largely conservative media, which is more interested in spectacular headlines and selling copy than in educating or expressing nuance;

3. the legislative branch of government, which is reliant on the former two institutions and which is highly scientifically illiterate; and

4. the social context of Argentina, which is not one of easy open debate and which is faced with a variety of social problems more pressing than bioscience development or social engagement around science.

Nonetheless, there was expressed hope that Argentina *could* develop a greater and broader sci-tech culture through enhanced science democracy. The gradual formation of channels of communication between state and society has been noted,[27] and the desire to interact with society amongst bioscience stakeholders is demonstrated by responses like the following:

> R11: I want social debate about stem cells, but I think this is not currently an agenda of the government to have this kind of debate. … We in society need to think and to express the opinion regarding stem cell therapies.

Similarly, both R4 and R20 were unequivocal that not enough is said about science, and in this case stem cell research, in Argentina.

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[27] M. Bastos, *supra*, note 6.

Given the apparent openness to increased engagement, at least amongst project respondents, the question remains, what is to be done to encourage this engagement, or the formation of a sci-tech culture, in Argentina?

RE-IMAGINING ARGENTINA: A MODEL FOR FORGING A SCI-TECH CULTURE?

While one respondent lamented that there exists no mechanisms for beginning the necessary dialogue, and while few other respondents had concrete ideas about suitable mechanisms, the evidence generated in the GET: Social Values Project supports a number of courses of action. Taken as a whole, support for three courses can be gleaned – (1) increasing public education, (2) institutionalising public participation, and (3) adopting rational, joined-up regulation – each of which will be addressed briefly.[28]

Public Education

Certain orthodoxies have evolved in the science governance setting. One of the strongest is the idea that resistance to new or proposed scientific directions is merely a function of people's ignorance of science, and that support for, and trust in, science will grow if the public is informed about science processes and potentialities (ie: if they can be 'filled up' with neutral and accurate scientific information).[29] This orthodoxy, commonly called the 'deficit model', assumes that social resistance to sci-tech innovations might be alleviated by public education campaigns aimed at increasing science literacy (or, more accurately, at selling science as a good and worthy public undertaking).[30]

The validity of this assumption, and of the model itself, has been challenged on the basis that it fails to recognise that science itself is not neutral, but rather is influenced by values, agendas, and social forces, and that resistance to science can originate from factors other than ignorance (eg: adherence to cultural associations, reliance on norms contrary to scientific endeavours, extreme risk aversion, and social (mis)trust of potentially risky technologies and the

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[28] It should be reiterated that the evidence generated in the GET: Social Values Project related primarily to ambitions and objectives for stem cell and/or regenerative medicine research, although some respondents did express a broader view. Thus, while these courses are supported by the respondents with respect to strategies for encouraging social uptake of stem cell science, they are equally, I submit, strategies for generating a sci-tech culture more broadly, and the deployment of these ideas (and of this evidence) for same is therefore legitimate.

[29] W. Bodmer, *The Public Understanding of Science* (London: The Royal Society, 1985).

[30] C. Toumey, "Science and Democracy" (2006) 1 *Nature: Nanotechnology* 6-7.

institutional/governance framework which will deploy them).[31] Having said that, the deficit model is not without some foundation. Low levels of understanding do not stop people from forming risk perceptions,[32] and it is implausible that well-informed and poorly-informed people make their minds up in the same way.[33] In short, accurate information and understanding are valuable to better evaluation and decision-making.

The evidence obtained in the GET: Social Values Project supports the conclusion that Argentine stakeholders believe that a lack of good public understanding is currently a key barrier to efficiently advancing science in Argentina. For example, R4, R6 and R9 indicated that people, including politicians, cannot discuss emerging biosciences rationally because they do not have the appropriate knowledge-base. R19 pointed out that Argentina is like two countries: the "people in the margins" have no information whereas the "upper class" has information, but not good information because it comes from the media. R20, who stated that people "just do not know what is going on," suggested the following:

> Informing people [is important], but … I mean really informing people. I'm not talking about propaganda or … brainwashing, I'm talking about them saying – 'This is what [stem cell research] is, these are the costs and these are the costs, there are many things we don't know' – because I think that kind of view is good from the scientific community.

Most respondents opined that, where people have views at all, their views are often very simplistic and they expect breakthroughs sooner than realistically

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[31] J. Ziman, "Public Understanding of Science" (1991) 16 *Science, Technology & Human Values* 91-99, B. Wynne, "Knowledges in Context" (1991) 16 *Science, Technology & Human Values* 111-121, B. Wynne, "Public Understanding of Science Research: New Horizons or Hall of Mirrors?" (1992) 1 *Public Understanding of Science* 37-43, A. Gross, "The Roles of Rhetoric in the Public Understanding of Science" (1994) 3 *Public Understanding of Science* 3-23, M. Siegrist et al., "Salient Value Similarity, Social Trust, and Risk/Benefit Perception" (2000) 20 *Risk Analysis* 353-362, and S. Priest, "Misplaced Faith: Communication Variables as Predictors of Encouragement for Biotechnology Development" (2001) 23 *Science Communication* 97-110.

[32] A. Hamstra, "Biotechnology in Foodstuffs: Towards a Model of Consumer Acceptance", in *SWOKA Research Report No. 7* (The Hague: Instituut voor Consumerntenorderzoek, 1991), L. Frewer, R. Shepherd and P. Sparks, "Biotechnology and Food Production-Knowledge and Perceived Risk" (1994) 96 *British Food Journal* 26-33, and A. Mucci and G. Hough, "Perceptions of Genetically Modified Foods by Consumers in Argentina" (2003) 15 *Food Quality & Preference* 43-51.

[33] P. Sturgis and N. Allum, "Science in Society: Re-Evaluating the Deficit Model of Public Attitudes" (2004) 13 *Public Understanding of Science* 55-74.

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possible, which could hurt the pursuit of science in the long term.[34] For example, R1, a regulator, stated:

> [There is] much more fantasy about [stem cell science]. I think the media contributes a lot to this fantasy; that everything is going to be cured … .

R8 stated:

> [People] have this simple view of [stem cell research]. … They think we are very close. They think that this stem cell research will prevent future diseases [and] cure all the genetic diseases. I mean, there is a lot of bad information and fantasy. … And people get very disappointed when someone says, 'Look, we are far away from having this as a normal therapy.'

R11 indicated that the misunderstanding is not limited to the lay public:

> Oh, a lot of fantasies. Even talking with doctors, they have a lot of fantasies. … [They] think that there could be some kind of magic treatment in stem cells. I think we need a lot of … education … .

Moreover, the danger to the progress of science was recognised if people have an inadequate knowledge-base or false information. For example, R5 stated:

> I am totally convinced that … if the public is not ready ... fears will emerge … and [people] will confuse [processes] so people need to be informed first for any country to make a profitable debate.

It is essential, then, that a portion of society becomes reasonably conversant about the nature and potential (presumed) applications of science and emerging related technologies, as well as their broader implications. This can be achieved, in part, through public education campaigns about the international/broad state of knowledge, domestic strengths and activity, innovation trends, existing and anticipated (realistic) public benefits, and longer-term desires for technology. However, an important caution must be issued: increasing science literacy in Argentina (or anywhere) must not become merely an exercise in 'selling science'.

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[34] One might note that, while these complaints have also been made in the UK, the social embedding of sci-tech innovation here means that such shortcomings are not *necessarily* a threat to scientific pursuit or uptake.

If public education is to contribute to the formation of an enduring affinity for science and innovation, it must:

- relate the formal contents of scientific knowledge (ie: the state of the art, trends, and short, medium, and long-term objectives);

- explain the methods and processes of scientific inquiry (ie: its approaches to formulating and then answering questions, and its means of funding and reporting same); and

- expose the culture of science and its particular values (ie: its means of patronage and exclusion, organisation, and control, and how they are embedded in scientific pursuit).

It is unlikely that there will exist a unanimously agreed goal (or set of goals) for science, or an agreed conception or objective (or set of objectives) for participation in science governance. This is a natural tension associated with plural societies. Nonetheless, key policy actors must speak with as unified a voice and as focussed, cohesive and honest a message as possible. Though complete 'public understanding' is unachievable, it is also unnecessary; only a critical mass of the target society need comprehend the subject technologies for (quality) public debate to thrive.

This raises important questions about when education should begin and at whom it should be directed. Building momentum for fundamental social change requires capturing imaginations at an early stage, and at least one respondent lamented the state of Argentinean middle and high school education with respect to science. A failure to inspire at this age can foreclose opportunities later in life, and will certainly put the longevity of any cultural shift in jeopardy. Obviously then, a multi-pronged approach is necessary, with some elements directed at school students, others at university students, others at adults, and yet others at specifically targeted groups.[35]

[35] P. Jensen et al., "Scientists who Engage with Society Perform Better Academically" (2008) 35 *Science & Public Policy* 527-541. With respect to targeted groups, it may take a special effort to avoid recreating and entrenching for the foreseeable future traditional gender roles which not only close scientific research doors to women, but which, in the reproductive and regenerative medicine contexts, could have serious implications for women's (reproductive) rights and health, a fact stressed by at least one respondent in the GET: Social Values Project.

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Public Participation

In response to the deficit model, scholars and stakeholders have argued for a more respectful, and potentially more successful, means of both generating support for scientific endeavours and involving publics in science policymaking. This 'contextual model' recognises that non-experts can acquire, comprehend, and deploy technical knowledge, and it involves individuals (specifically lay individuals) in a variety of upstream engagement activities, the objective being to better inform policy decisions and to promote policies that will enjoy greater and quicker uptake and thereby generate more immediate and durable social benefits.[36]

Respondents in the GET: Social Values Project identified a clear shortcoming in existing debates, noting that, when they exist at all, they are often limited to economic aspects of science and need to be expanded to include questions of research, planning and desired therapies. The value of real debate was noted by multiple respondents. R5 stated:

> [E]ach country should try to contribute to the debate … . I don't know the view of my country. I could guess, but I don't know. … I would like to know what my country's people would like to say about [stem cell research and bioscience more generally].
>
> [It] is very important to open the debate and to have opposite visions of the subject sitting at the same table and think that maybe both have rights; that not one has the truth and one has not – maybe both have the truth. You need to really conclude what is the best for the country and for the people of the country. That is … why I think it is so crucial that we debate these things openly.

While anticipating the emotional nature of any potential debate, R3 nonetheless stated:

> I think it is beneficial. But we have to be very responsible in this because Argentina has a trend to have discussions like a civil war … and some days it's not easy for the Argentinean society. … But … it is unavoidable. You have [to] discuss things. You have to make a debate [with different] points of view.

It was additionally acknowledged that participation would help everyone, including scientists, who do not know enough about law or ethics.

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[36] C. Toumey, *supra*, note 30.

While many of the respondents remained unclear as to the exact nature or structure of the improved engagement they sought, some clearly leaned toward a contextual participatory model. Of course, a participatory model may contain a deficit (ie: information provision) element, but it is deeper, soliciting much more from the target audience.[37] Thus, while testing and enhancing levels of science literacy, it should additionally solicit cultural predispositions, important value-perspectives, and shared visions of potential futures, and may even contribute to changes in how science is undertaken. Of course, the functional limits of these exercise must be acknowledged (eg: they involve relatively small numbers of people).

Sceptics and science antagonists are, of course, inevitable in such an open approach, and their mobilisation in Argentina can be predicted. The key for science protagonists (such as the Ministry of Science) is to neutralise the most damaging consequences of discord, and to harness the most positive and creative consequences of disagreement. Thus, it is absolutely essential to fashion engagement exercises which draw on, and vindicate, democratic principles such as respectful dialogue, reason, and consent. Antagonists with inflexible agendas who wish only to hijack the participatory process – which process must be ongoing – might simply be excluded, for they cannot add any value to the exercise.[38]

Ultimately, some form of controlled engagement which feeds into optimistic but cautious, evidence-based, and forward-thinking policies must be utilised if the generation of a sci-tech culture is to be encouraged.[39] Well-conceived participation will:

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[37] C. Pitkin and A. Leitch, "Science Communication as Community Engagement: A Case Study in Regional Australia", in B. Bonmatí, ed., *supra*, note 26, 395-399.

[38] Such antagonists frequently ignore the fact that the knowledge-attitude nexus which policy-makers are trying to understand, is often contingent, and must therefore be explored through a variety of fora and then re-tested. For more on this contingency, see M. Bauer et al., "European Public Perceptions of Science" (1994) 6 *International J Public Opinion Research* 163-186, and E. Einsiedel, "Understanding 'Publics' in the Public Understanding of Science", in M. Dierkes and C. von Grote, eds., *Between Understanding and Trust: The Public, Science and Technology* (Amsterdam: Harwood, 2000) 205-216.

[39] While the idea of 'controlled engagement' may have Orwellian undertones, it is only intended to signal that the integrity and therefore the legitimacy of the process must be protected from those who would use it for ends other than to feed good qualitative evidence to the policymaking process (ie: those who would resist serious debate or the engagement with reason or rational argumentation). On this point, one notes the shortcomings of the modern media: see D. Dickson, "The Case for a 'Deficit Model' of Science Communication", 27 June 2005, *Science & Development Network*, available at http://www.scidev.net/en/editorials/the-case-for-a-deficit-model-of-science-communic.html [accessed 3 August 2009].

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- mobilise the imagination and thereafter the energy of publics, which will, in turn, contribute to the improvement of subject technologies, or the development of new ones altogether;

- give rise to thoughtful and reasoned support within the interested sectors whose enthusiasm and action can infect other, ambivalent, or even mildly oppositional, segments of society, thereby creating a social momentum; and

- create new roles for actors, including scientists and lay publics, and thereby redefine relationships, as has occurred in other jurisdictions.[40]

Examples of mechanisms which might serve as vehicles for doing this include focus groups, interactive workshops, citizen juries, surveys, large-scale polls, and so on, but could also involve more creative methods, such as game playing, issue-exploration through art or theatre or public festivals.[41]

Through such engagement and the positive mobilisation that it can promote, a sci-tech culture might be encouraged. In its absence, social understanding and uptake of innovations may remain tentative, sporadic and controversial, making it difficult to develop technologies and processes tailored to Argentina's environmental, cultural, and socio-economic setting.[42] A failure to tailor innovation to Argentina's needs will mean that Argentina will not benefit sufficiently from the technological revolution to which it is already contributing.

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[40] J. Pont, "Public Participation in Climate Change Knowledge Production: An Assessment of Communication Models", in B. Bonmatí, ed., *supra*, note 26, 387-389, and T. Tramullas et al., "Science and Society: Twelve Cliché Questions and Forty-Eight Controversial Answers" in B. Bonmatí, ed., *ibid*, 385-387.

[41] One might query whether the creation of curiosity and trust, a common consequence of public engagement, can be the explicit goal of public engagement, and, if it is made to be so, whether this undermines the goal of public engagement. While public engagement has been directed at encouraging better science or science policies, I believe it has always had an element of promoting science curiosity or of 'science-ism', and encouraging trust through the involvement in trajectory-choice. That these effects are explicitly recognised and desired does not detract from the value or legitimacy of the engagement project so long as that project is pursued in good faith and with transparency.

[42] However, I note that GM crops, a lightning-rod for controversy in the UK, was widely adopted by Argentine farmers with very little debate, and was (for the most part) silently accepted by a public with other, more pressing concerns: see A. Mucci, G. Hough and C. Ziliani, "Factors that Influence Purchase Intent and Perceptions of Genetically Modified Foods Among Argentine Consumers" (2004) 15 *Food Quality & Preference* 559-567, and Scientific American, Worldview Project, available at http://www.saworldview.com/. Indeed, almost all respondents in the GET: Social Values Project confirmed that the adoption of GM crops did not give rise to significant debate in Argentina, partially because its most direct and immediate impact is on farmers, as opposed to broader groups (like patients).

Joined-Up Regulation

While the above inclusive and interactive governance processes are important, there remains a central role for governments or arms-length governmental bodies, which should be clear about their policy goals.[43] Given the uncertainty around predicting future technologies and their interactions with complex systems, it is important for governments to imagine good/ideal outcomes for society, for public health, for sci-tech innovation, and for the industries implicated, and to fashion a regulatory framework that makes it possible. At the same time, they must recognise that regulation will constitute only one *component* of a broader innovation and health delivery landscape with both formal and informal elements.[44] As such, they must identify the links between socio-economic, innovation, and health objectives, and understand them as integrated entities.[45] They must strive for a degree of 'joined-upness' so that actions at one innovation focal point (eg: stem cells) do not cause unanticipated problems at another (eg: human trials or commercialisation), each of which will have unique, context-dependent issues, players and risks.[46]

While most respondents in the GET: Social Values Project felt that historical efforts at legislating science in Argentina were not particularly well conceived, or were now simply too outdated to be maximally effective, they almost unanimously felt that rational, evidence-based, and informed government boundary-setting was essential in the new sci-tech climate. R2, a regulator, suggested that the governance regime must facilitate science while demarcating

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[43] See C. Lyall, J. Smith & T. Papaioannou (eds.), *The Limits of Governance: The Challenge of Policy-Making for the Life Sciences* (Aldershot: Ashgate, 2009).

[44] Maximising bioscience benefits may also necessitate considering ways in which Argentina might improve regional infrastructure and therefore conditions for bioscience innovation so that it retains a regional competitive advantage. For more on the regional element of innovation, see T. Papaionnou, "Regional Innovation and Pubic Policy" (2007) *Briefing No. 13*, available at http://www.genomicsnetwork.ac.uk/media/regional%20innovation%20and%20public%20policy.pdf [accessed 21 April 2009].

[45] The benefits of early inclusion of these broader considerations is supported by empirical research conducted by Innogen in the area of bioscience innovation: see T. Papaionnou, "Building Innovative Capabilities Through Pubic-Private Collaboration in Genomics and Biotechnology" (2007) *Briefing No. 12*, available at http://www.genomicsnetwork.ac.uk/media/building%20innovative%20capabilities.pdf [accessed 21 April 2009].

[46] S. Harmon and G. Laurie, "The Regulation of Human Tissue Use and Regenerative Medicine in Argentina: Making Experience Work" (2008) *Policy Brief No. 4:2008*, available at http://www.mincyt.gov.ar/index.php?contenido=comision_celulas_madre [accessed 21 April 2009]. Multiple respondents in the GET: Social Values Project expressed a preference for a general law on basic and non-clinical research to which dependent and more specific regulations could be added where necessary which address specific technologies.

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forbidden pursuits and practices, thereby giving actors clear guidance. R10, a legal-ethical academic, stated:

> I think that, today, you need to regulate because the power and possibilities in the scientific field are so much, and the possible effects are so terrible … . With a lot of care … and consulting specialists [scientific and bioethical], something must be done.

R12, a federal judge, noted the quality of Argentina's science and opined that good regulation which encourages useful outcomes would be helpful.

While all respondents in the GET: Social Values Project felt that government boundary-setting is essential, they did not all agree that formal regulation was essential. Indeed, in this regard, opinions fell into four primary camps:

- No Legislation: It is too early for legislation in the stem cell setting; it might be better for this area to be overseen by a regulatory committee first so some oversight and advice can be offered as the field develops, and any furore is avoided (R7, R21,). Alternatively, legislation ought to be avoided because the tendency is to ban and pass bad laws (R16).

- Narrow Legislation: A stem cell-specific law is important because of the socially important issues thrown up by this research (R5, R10, R11, R14, R17, R19).

- General Research Legislation: Relevant issues and procedures are shared with other practices and techniques so a general medical research law is more useful, under which technique-specific regulations might be drafted by the executive on an as-needed basis (R1, R4, R6, R8, R18).

- General Medical Legislation: It is much more important to regulate the clinical setting than basic research; the safety of the patient is the most important element currently missing from the Argentine biomedical regulatory setting (R3, R12, R15).

Despite this divergence of views, most respondents recognised the need for a rational joined-up bioscience regime with some boundary-setting and oversight functions performed collaboratively by the Ministries of Science and of Health, having first identified and framed core themes and public objectives for bioscience. Such collaboration is essential insofar as it would better encourage the formulation of jointly relied-on processes which capture the diversity and

richness of opinion and thereby offer a broader, more creative base from which to adapt regulation, which will concomitantly address a wider range of concerns. A proper foundation will also go some way to avoiding 'factionism'; if the regulatory system is too complex (and too onerous), many potential players will be squeezed out, and if the whole does not interact rationally and simply (funding, research governance, corporate governance, intellectual property, etc.), expenses will be wasted and opportunities lost, as developing countries are discovering all the time.

Summation: The Need for Compressed Social Evolution

Shifting social perspectives is never easy – social mores transform slowly, unevenly, even osmotically – and the formation of a sci-tech culture in Argentina poses no mean task, though one should take notice of the general esteem in which scientists are held by most Argentineans.[47] Importantly, there are precedents of such cultures having been fostered elsewhere. Although obviously an uneasy comparator, China is compelling insofar as it managed its transformation while shifting from developing to developed, doing so from an arguably less enviable socio-economic position than Argentina enjoys, and with a much larger polity to reverse and mobilise.[48] Like China, Argentina might encourage the formation of a sci-tech culture through 'compressed social evolution'; that is the consciously accelerated transformation of the socio-cultural environment toward a desired perspective. It is 'compressed' insofar as it is not purely evolutionary or a matter of happenstance, but is rather more consciously (and conscientiously) directed, with policy leaders identifying, targeting and achieving ambitious but realistic socio-scientific/technological objectives while simultaneously (and aggressively) building public support for same.[49]

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47 Stekolschik et al., *supra*, note 20.

48 China is socially, politically, legally, culturally, historically and geographically different from Argentina, and its lower tolerance of sharp divergence from state objectives negates a need for it to navigate the 'minefield' that Argentine policymakers and science protagonists might expect: See F. Luna and A. Salles, *supra*, note 23.

49 Through persistent public education, targeted public funding of science, and domestication of international standards (and interpreting them on a utilitarian basis), China has transformed itself from insular, rural, agrarian society to international leader in a variety of technology sectors, including agro-genomics. Since the end of the Cultural Revolution in 1978, and particularly through the 1990s, China adopted a science-solutions approach to development and social change, deploying science and encouraging scientific uptake and innovation whenever possible, and rewarding same through funding and recognition. China continues to make strides by identifying Chinese needs and strengths for saturation funding, and it is retaining governmental authority in the face of international dilution of sovereign capacities: see S. Harmon, "Biotechnology Innovation and Patenting in the Developing World: China – A Giant Among Nations?" (2007) 12 *J Intellectual Property Rights* 72-85, S. Harmon, "International Public Health

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While one might acknowledge that technologies (or their deployment) are not always positive, there is ample evidence to the effect that selective pursuit of high technologies can be beneficial to developing countries in Argentina's position.[50] In undertaking the shift envisioned in this paper, however, it is conceded that Argentina must find some balance between caution and pace in innovation while simultaneously building social momentum around sci-tech and exercising ongoing reflexivity or self-assessment and re-evaluation in relation to sci-tech advances.[51] In pursuing this course (or rather *if* pursuing this course), Argentina will alternatively suffer and benefit from a number of factors particular to its temporal and cultural context.

On the negative side, all things have accelerated since China embarked on its course. Thus, whereas Argentina may wish to be cautious and measured, it might rather have to be more decisive, undertaking a concerted not-so-long march which facilitates the (rapid) formation of said culture. Similarly, efforts might be expected to trigger the mobilisation of certain conservative institutions while shining a harsh light on scientists who may just wish to simply 'get on with it' in anonymity. Finally, Argentina might be hindered by the fact that, like many other developing countries, it faces a host of more pressing social problems that clamour for public funds, a fact acknowledged by a number of respondents.

On the positive side Argentina ought to be facilitated by the fact that members of the Argentine public ascribe to scientists a high level of credibility and prestige.[52] Moreover, a national survey in 2003 found that most Argentineans have favourable attitudes toward science and technology, and that most Argentineans believe that (1) science and technology improve culture and quality

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Law: Not so much WHO as why, and not enough WHO and why not?" (2009) 12 *Medicine, Health Care & Philosophy* 245-255. Importantly, as alluded to above, the Chinese have a dearth of robustly democratic institutions, a condition with which Argentineans are not similarly faced. This fact makes it easier for Chinese authorities to compress social evolution. In the Argentinean case, as indicated in the main text above, compression would entail a concentration of promotional and participatory efforts, without the same narrowing and silencing mechanisms that might be expected in the Chinese context.

[50] For more on technology leap-frogging, see B. Petrazzini and A. Guerrero, "Promoting Internet Development: The Case of Argentina" (2000) 24 *Telecommunications Policy* 89-112, R. Davison et al., "Technology Leapfrogging in Developing Countries: An Inevitable Luxury?" (2000) 1 *E Journal Info Systems Developing Countries* 1-10, J. Cascio, "Alternative Energy in Pakistan" (2003), available at http://www.worldchanging.com/archives/000234.html [accessed 28 September 2009], J. Cascio, "Leapfrog 101" (2004), available at http://www.worldchanging.com/archives/001743.html [accessed 28 September 2009], and T. Altenburg, H. Schmitz and A. Stamm, "Breakthrough? China's and India's Transition from Production to Innovation" (2004) 36 *World Development* 325-344.

[51] A. Moutinho, "Public Policies for Scientific Culture: When Maturity Brings About Evaluation" in B. Bonmatí, ed., *supra*, note 26, 405-407.

[52] Stekolschik et al., *supra*, note 20.

of life, and (2) the government should increase public funding of science and technology.[53] Having said that, it also found that a majority of the population is poorly informed about science and technology issues, and, overall, the general positive attitude is accompanied by a precautionary attitude toward the consequences of science utilisation.

Ultimately, scientists and policymakers must interact more openly, positively and profitably with the Argentine polity over stem cell research and other biosciences, and it is naïve to think that Argentina can or should avoid the suggested transformation, despite the pitfalls it engenders. Advancing a sci-tech culture is probably imperative if Argentina wishes to maximise potential, generate new possibilities, and emerge as an international competitor (or regional leader) in the new scientific era. The overall evidence obtained in the GET: Social Values Project suggests that, while Argentina does not yet manifest a sci-tech culture characterised by robust science democracy and engagement as a means of encouraging curiosity and public support of science endeavours, there is support for its creation, at least amongst the stakeholders interviewed, all of whom had a positive outlook on the possibilities that high technologies offer Argentina, and they felt that much depends on individual personalities, particularly the widely respected Minister of Science, Lino Barañao.

CONCLUSION

The empirical evidence generated by the GET: Social Values Project tells a particularly Argentine story. It is a story of:

- Sadness: that healthcare and science education are enjoyed so unevenly in Argentina where such good science is being pursued;
- Acceptance: of past failures and injustices in the science (and social) setting;
- Ambition: to perform more world class bioscience;
- Optimism: in the domestic human resource capacity to achieve bioscience innovations;

[53] L. Vaccarezza, C. Polino and M. Fazio, "Measuring Public Perception of Science in Ibero-America: The RICYT/OEI's Study and Argentina's National Survey", in B. Bonmatí, ed., *supra*, note 26, 436-443.

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- Concern: that Argentine biosciences will never mature to a truly internationally competitive scope and level unless the public is supportive;

- Ambivalence: over whether good public engagement can be achieved in the prevailing social setting; and

- Distress: that the social and political setting may continue to hamper Argentine science and knowledge generation for some time to come.

This paper engaged with the latter elements, arguing that the formation of a sci-tech culture, and the concomitant acceptance of new technologies, will be enhanced where people are satisfied that (1) the technologies could be beneficial to society and/or themselves, (2) they have had some role in the consideration of those technologies, and (3) there are reliable mechanisms to encourage their proper development and just deployment. The 3-pronged model articulated above, and generally supported by respondents in the stem cell and regenerative medicine research context, could help lead Argentina to such a state, but it obviously requires exposure of actions and desires. And in the Argentine context, there is a danger to such exposure, and in making hidden battles public (and explicit): scientific privileges which are currently enjoyed could be challenged or even retracted. But some aspects of value battles can be turned to more productive dialogues if the polity is respectfully engaged, and, as already claimed,[54] some values that are currently politically enforced do not actually represent the true values of the polity. Having been so engaged, those who remain opposed to specific technologies might nonetheless be satisfied that (1) their own concerns were heard and understood, and (2) they will be able to (personally) avoid specified and deplored technologies once they are mainstreamed. This is how society accommodates plurality and evolves to better reflect the true values and practices of its people.

In any event, the evidence generated thus far, admittedly a drop in the proverbial bucket, and relating only to stem cell and regenerative medicine research, suggests that (at least some) Argentine stakeholders are interested in shaping policies which are democratically founded, which encourage honesty in all parties, and which contribute to international socio-ethical debates. What does all of this mean for the immediate future of policy-making in Argentina? I would suggest that Argentine policymakers might:

- acknowledge that well-conceived participation encourages trust, honesty, and dialogue (ie: stakeholders being prepared to expose their interests and

[54] F. Luna and A. Salles, *supra*, note 23.

objectives, conscientiously exchange ideas, and refine their positions), and therefore should (1) recruit allies in civil society and, at both closed and public meetings, (a) consider technological trends, objectives and value, and (b) develop understandings of assumptions, agendas, desires, and underlying moral values driving various stakeholders;

- consider how biosciences are changing and could change Argentine society and healthcare, now and in the future, for elites and the general population, and therefore should (2) undertake and/or fund a variety of horizon-gazing exercises, some expert driven, some more broadly inclusive; and

- recognise that innovation is interdisciplinary and that regulation can affect a variety of practices, some of them not directly governed by that instrument, and therefore should (3) fashion a governance regime which recognises inter-operability without recreating complexity (ie: avoid technologically-contingent regulation and encourage regulation that is navigable by non-experts shepherding research from bench to bedside).[55]

It is reasonable to believe that these steps could vindicate two of the values consistently claimed as important by all respondents in the GET: Social Values Project, namely 'honesty in science and science governance' and 'public trust in science'.

[55] In this respect, note C. Lyall, J. Smith and T. Papaioannou, *supra*, note 43.

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